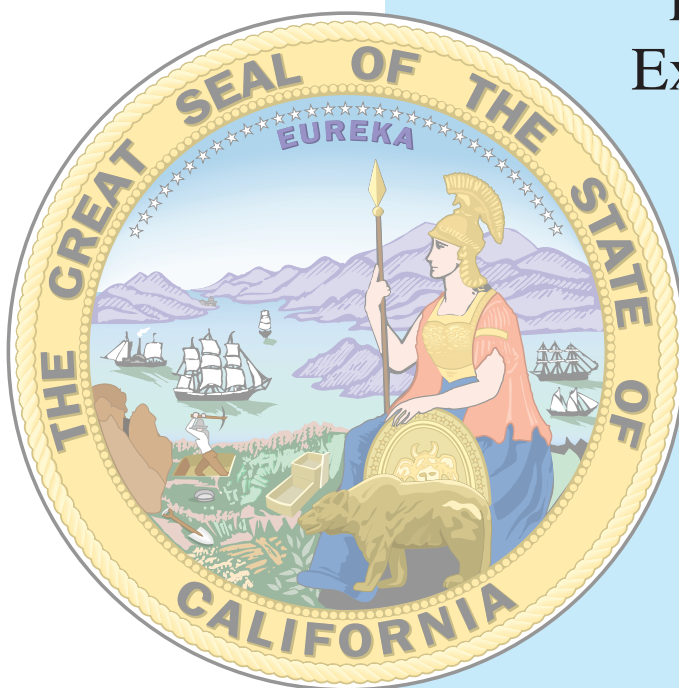


Health and Environmental Assessment of the Use of Ethanol as a Fuel Oxygenate

Report to the
California Environmental
Policy Council
in Response to
Executive Order
D-5-99



December 1999

Work performed under the auspices of the U. S. Department of Energy by Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

Health and Environmental Assessment of the Use of Ethanol as a Fuel Oxygenate

Contents for Volumes 1–4

Volume 1: *Executive Summary*

Volume 2: *Background Information on the Use of Ethanol as a Fuel Oxygenate*

David W. Rice

Volume 3: *Air Quality Impacts of the Use of Ethanol in California Reformulated Gasoline*

Bart E. Croes, P.E.; Paul Allen, P.E.; Richard Bradley, P.E.;
Dongmin Luo, Ph.D.; Richard Vincent, P.E.; and Luis Woodhouse, Ph.D.

Volume 4: *Potential Ground and Surface Water Impacts*

Chapter 1: *Potential Scenarios for Ethanol-containing Gasoline Released into Surface and Subsurface Waters*

David W. Rice; Susan Powers, Ph.D.; and Pedro J.J. Alvarez, Ph.D.

Chapter 2: *A Critical Review: The Effect of Ethanol in Gasoline on the Fate and Transport of BTEX in the Subsurface*

Susan E. Powers, Ph.D.; and Stephen E. Heermann, Ph.D.

Chapter 3: *The Effect of Ethanol on BTEX Biodegradation and Natural Attenuation*

Pedro J.J. Alvarez, Ph.D., and Craig S. Hunt, Ph.D.

Chapter 4: *Screening Model Evaluation of the Effects of Ethanol on Benzene Plume Lengths*

Walt McNab, Ph.D.; Stephen E. Heermann, Ph.D.; and
Brendan P. Dooher, Ph.D.

Chapter 5: *Potential Impact of Ethanol-containing Gasoline on Surface Water Resources*

David W. Layton, Ph.D., and Jeffrey I. Daniels, Ph.D.

Chapter 6: *Environmental Transport and Fate of Fuel Hydrocarbon Alkylates*

Alfredo A. Marchetti, Ph.D.; Jeffrey I. Daniels, Ph.D.; and David W. Layton, Ph.D.

Chapter 7: *Evaluation of Analytical Methods for the Detection of Ethanol in Ground and Surface Waters*

Carolyn Koester, Ph.D.

Chapter 8: *Screening Analysis of Potential Groundwater Resource Impacts from Gasoline Containing Ethanol or MTBE Using an Empirically based, Probabilistic Screening Model*

Brendan P. Dooher, Ph.D.

Chapter 9: *Knowledge Gaps Regarding the Ground and Surface Water and Impacts of Ethanol-containing Gasoline and Recommendations for Future Research*

David W. Rice; Pedro J.J. Alvarez, Ph.D.; Susan E. Powers, Ph.D.; Harry R. Beller, Ph.D.; Staci R. Kane, Ph.D.; Jeffrey I. Daniels, Ph.D.; David W. Layton, Ph.D.; and Brendan P. Dooher, Ph.D.

Chapter 10: *Response to Comments*

David W. Rice

Volume 5: *Potential Health Risks of Ethanol in Gasoline*

Staff Report, Office of Environmental Health Hazard Assessment